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# THE INCENDIARY EFFECTIVENESS OF HEI FILLERS IN 20MM PROJECTILES (U)

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# THE INCENDIARY EFFECTIVENESS OF HEI FILLERS IN 20MM PROJECTILES (U)

## ABSTRACT


### Objective

To evaluate the incendiary effectiveness of various fillers in 20mm projectiles against aircraft type fuel cells filled with aviation gasoline.

### Summary

Critical distances for obtaining fires against each of two different target arrangements were determined for fourteen combinations of shell types and fillers. Standard target set-ups (B-2 In-Line and Miss-Distance) were used for the aviation gasoline fuel cells.

### Conclusion

The behavior of the filler combinations was consistent with earlier trends. Projectiles modified to perform better against one type of target set-up (e.g., B-2 mockup) were poorer against the other type of target, i.e., Miss-Distance.

### Recommendations

1. Further investigation of a promising design incorporating a follow-through slug be conducted.

2. Investigations be made in larger calibers, in the hope that an optimum combination of performance characteristics may lie in this direction.

# THE INCENDIARY EFFECTIVENESS OF HEI FILLERS IN 20MM PROJECTILES (U)

CONTENTS

## I. INTRODUCTION

A. Standard 20mm high explosive incendiary projectiles such as the M97 contain tetryl and an incendiary mixture in fixed proportion. The combination of fillers is used to give fragmentation and non-incendiary effectiveness as well as fuel ignition.

B. The major performance feature of interest in these tests, however, is the ability of the projectile to produce fuel fires in an aircraft under varying conditions of attack. Since impacts can occur on an aircraft at some distance in line with or to the side of a fuel cell proper, the non-direct-hit incendiary effectiveness of this type projectile is a major criterion in projectile performance.

C. An important characteristic of incendiary projectiles, therefore, is the maximum distance from projectile impact to an aircraft fuel cell wall, both laterally and along the projectile trajectory, at which a fuel fire can be obtained.

D. Considerable, but incomplete, data had been obtained prior to the firings described in this report. These earlier firings indicated that, for fuel cell walls perpendicular to the trajectory, the incendiary mix was the predominant damage factor. Conversely, against a fuel cell with the target wall parallel to the trajectory, high explosive filler had the major damage potential, providing the fragmentation necessary to produce fuel leakage.

E. The ammunition used in the tests reported herein had not only varying ratios of explosive-incendiary mix, but also various types of incendiary filler. (See descriptions of British BRF round and Denver Incendiary Mix.)

## II. DESCRIPTION OF MATERIEL

A. 20mm Mann barrels mounted on Frankford Arsenal rests were used to fire the projectiles tested, at a gun-to-target range of approximately 50 to 100 feet.

B. The target fuel cells were of the self-sealing, B50 type, 90% full of aviation grade gasoline. When the fuel cells were damaged or non-sealing leaks resulted from firing, composite patches of rubber and aluminum plates were applied over the damaged cell openings. This procedure has been routine in tests of the type described. Firings were conducted under a wide range of ambient temperatures, during various seasons of the year.

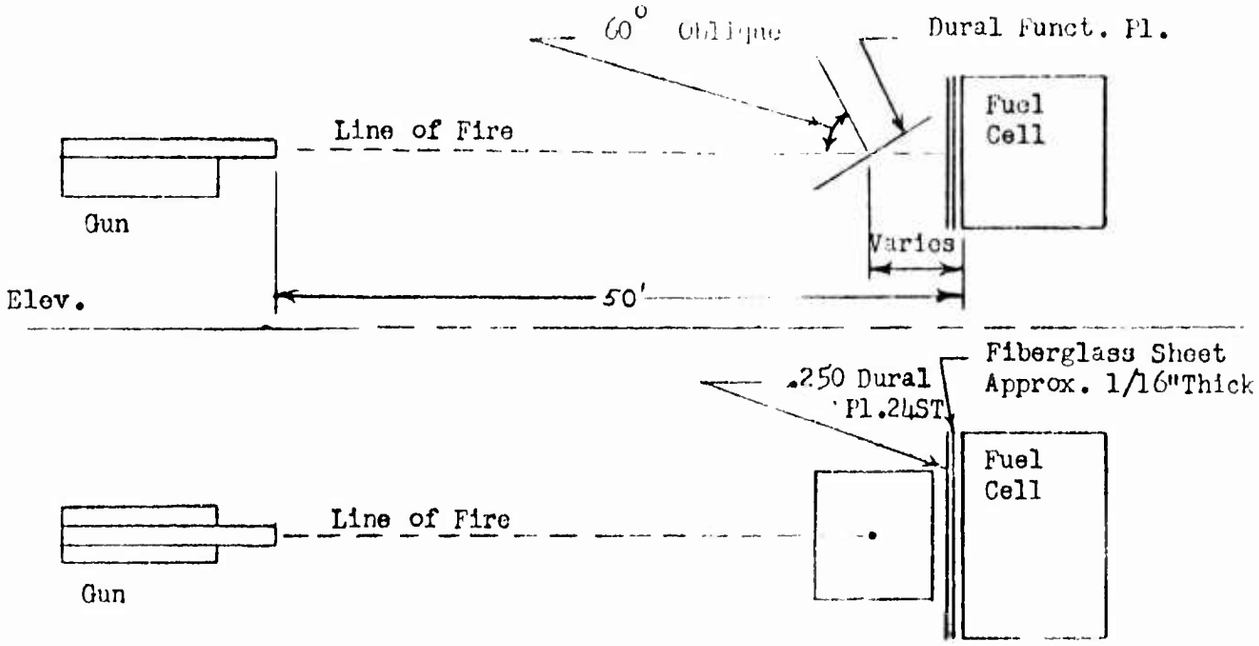
C. The ammunition types are described in the Table in E, below. Variations in loading were achieved in Development and Proof Services assembly plants. The exceptions to this local loading procedure were the SID round and the British BRF 521 rounds, fired as received from Weapon System Laboratory of the Ballistic Research Laboratories. The fuzes used were of the M505 and T196E4 point-detonating type, except that the British BRF rounds

were fuzed with the MK1 MG-917. Tetryl filler was pressed at 40,000 psi, Incendiary Mix 142 at 20,000 psi or less.

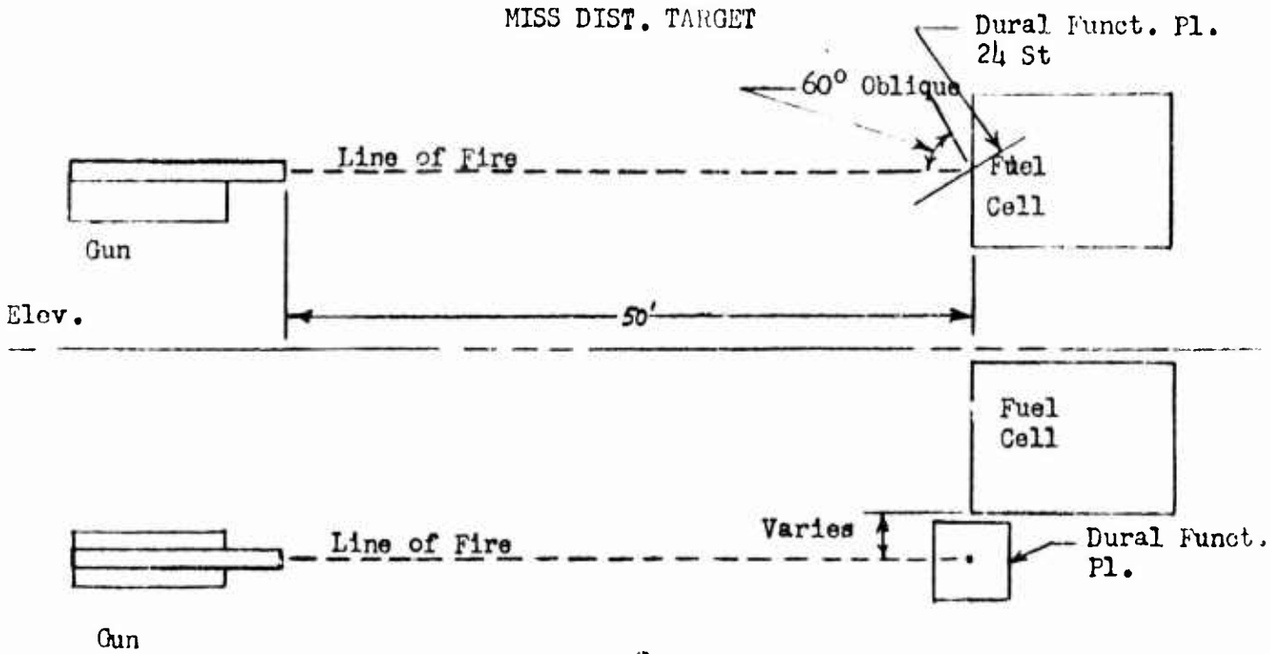
D. The target B50 type fuel cell was mounted on an angle-iron stand which served to support the cell in a relatively unconfined position. The burster plates for the test ammunition were sheets of locally available 24S-T aluminum placed at 60° obliquity. For the B-2 mockup phase, .040" dural was the first plate and .125" or .250" dural was the second plate in the target set-up. For the Miss-Distance firings, .040" or thicker projectile functioning plates were used. Figure 1 on the following page illustrates the two set-ups.

INCENDIARY EFFECTIVENESS TARGETS

B-2 TARGET




MISS DIST. TARGET



E. Table of 20mm Ammunition Type-Filler Combinations Fired

| TYPES | FILLERS |
|---|---|
| HEI, M97 and T282E1 (four fillers each) | 0% Incendiary Mix 142, 100% Tetryl<br>30% Incendiary Mix 142, 70% Tetryl<br>70% Incendiary Mix 142, 30% Tetryl<br>90% Incendiary Mix 142, 10% Tetryl |
| HEI, T282E1 (Mod.) | Loaded by Denver Research Institute (two grams of Zirconium, 20-60 mesh, Tyler screen, in base, eleven grams MOX-2B main charge, two grams 97/3 RDX/wax top-off charge) |
| HEI, T282E1 (Mod.) | Same as above but without RDX/wax top-off charge |
| HEI, T282E1 | Standard (MOX-2B) |
| HEI, T282E1 | SID (Lead Shot and Zirconium Filler) |
| HEI, T216E1 | Denver Incendiary Mix, as for first T282E1 (Mod.) above |
| HEI, T216E1 (Mod.) | Special Slug, 135 grains (.314 inch high by .526 inch diameter) added in base of shell. |
| BRF - 521 | British bromine pentafluoride main charge with incendiary mix and British fuze |

F. Sample Filler Weights of HEI Projectiles:

| SHELL | WT. EMPTY | LOADED | WT. IM 142 | WT. TETRYL | RATIO HE/I |
|---|---|---|---|---|---|
| M97 | 100.52 gms | 108.93 | 5.88 gms | 2.52 gms | 30/70 |
| T216 | 64.41 gms | 80.18 | 4.77 gms | 11.01 gms | 70/30 |

## III. DETAILS OF TEST

A. PROCEDURE

1. Firings were conducted at particular distances in the B-2 target phase for which previous data was limited. The functioning plate was usually at 60° obliquity and the distances between functioning plate and target fuel cell were never greater than 96 inches along the trajectory of the projectile. For the Miss-Distance phase, groups of three rounds were fired to determine a lateral distance, between point of impact and side of fuel cell, at which no fires occurred. These distances ranged from 6 to 27 inches. At the conclusion of firing, surplus aviation grade gasoline was drained from the target fuel cell and used to fill the target cells for subsequent firing. Gasoline fires were rapidly extinguished by the use of foam and $CO_2$ delivered from fire-fighting trucks.

B. RESULTS

1. Summaries of firing data are presented in Figures 2 and 3, which follow this section. Round-by-round data for the M97 and T282 standard and modified, T216E1 standard and modified, and the BRF 521 projectiles are presented in Table 3 in Appendix B.

2. The data presented in the aforementioned tables and graphs contains information obtained in previous firings (Ref. APG Firing Records P-55880 and P-55926), as well as data from the subject firings.

3. Against the In-Line, or B-2 target, both the 20mm HEI M97 and T282E1 projectiles, when loaded with 90% of IM 142 and 10% tetryl, yielded fires (1 in 3 for each projectile) at the maximum fuel cell distance tested. This distance (functioning plate to fuel cell masking plate) was 96 inches. Generally, as the percentage of tetryl was increased, the maximum distance at which fires occurred decreased. With a 100% tetryl load, no fires were provided by the T282E1 projectile in three trials when the plate to target distance was 18 inches.

4. Against the lateral or Miss-Distance target, the T282E1 type projectile loaded with 100% tetryl yielded a fire (1 out of 3 trials) at a maximum distance between impact point and fuel cell wall of 18 inches. As the percentage of incendiary mix was increased, and that of high explosive decreased correspondingly, the incendiary effectiveness of T282E1 and M97 types against this target decreased.

5. The SID (Modified T282E1) round was effective in starting fires against the B-2 or In-Line target mockup at all distances including the maximum tested (96 inches), where it produced 3 fires in 3 trials. The same round was relatively ineffective against the Miss-Distance target mockup (no fires in 3 trials at nine inches).

6. The special modification of the T216E1 involving the addition of a steel slug to the bottom of the shell cavity appeared to improve the performance of the round slightly. This modified round yielded 1 fire in 3 trials at B-2 target distance of both 45 inches and 63 inches and caused large single leaks in the cells even when no fires resulted. The standard T282E1 projectile yielded a fire (1 in 7 trials) at a maximum distance of only 36 inches against the same target set-up. It appeared also that only small leaks in the target cell wall resulted at 36 inches or greater distances when the unmodified T282E1 was fired.

7. The British BRF 521 round yielded at least 1 fire at all B-2 target distances tested, up to the maximum of 96 inches. Against the Miss Distance target, this round failed to show effective performance.

FIGURE 2

(No. Fires/No. Trials)

FIRE FREQUENCY VS PROJECTILE IMPACT DISTANCE

20MM HEI PROJECTILE VS B-2 (IN-LINE) TARGET .040 in. Dural 1st Plate
.125 in. Dural 2nd Plate

| PROJECTILE AND FILLER | DISTANCE BETWEEN PLATES 1 & 2 (inches) | | | | | | | | TYPE OF GASOLINE LEAKAGE |
|---|---|---|---|---|---|---|---|---|---|
| | 18 | 27 | 36 | 45 | 54 | 63 | 72 | 96 | |
| M97 with 0% IM 142/ 100% Tetryl | 0/1* | - | 2/3,0/2* | 1/3 | 1/2,0/3* | 2/2 | 0/3* | - | Small |
| M97 (Std) with 30/70 | 7/7 | 5/8 | 2/4 | 0/3 | 0/3 | - | - | - | Small |
| M97 with 70/30 | 3/3 | - | 3/3 | 2/3 | 1/1 | 1/1 | 1/3 | 0/3* | Medium |
| M97 with 90/10 | 3/3 | - | 3/3 | 4/4 | 1/1 | 1/3 | 0/1,1/2* | 1/3* | Large |
| BRF-521 | - | - | - | - | 2/3* | 1/3* | 2/3* | 1/3* | Large |
| High Capacity T282E1 with 0% IM 142/100% Tetryl | 0/3 | - | - | 0/1 | - | - | - | - | Small |
| T282E1 with 30/70 | 1/3 | 1/3 | 0/3* | - | - | - | - | - | Medium to Large |
| T282E1 with 70/30 | 3/3 | - | 3/3 | 3/3 | 2/3* | 0/3* | - | - | Medium to Large |
| T282E1 with 90/10 | 3/3 | - | 3/3 | 3/3 | - | - | 3/3* | 1/3* | Large |



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FIGURE 2 (Contd)

| PROJECTILE AND FILLER | DISTANCE BETWEEN PLATES 1 & 2 (inches) | | | | | | | | TYPE OF GASOLINE LEAKAGE |
|---|---|---|---|---|---|---|---|---|---|
| | 18 | 27 | 36 | 45 | 54 | 63 | 72 | 96 | |
| T216E1 (MOX2B/Zr)** | 3/3(12"), 2/3* | 3/4* | 1/7* | 0/3* | - | - | - | - | Small |
| T216E1 (BRL MOD.) MOX2B plus 135 gr. .526 in. dia. base plug | - | - | - | 1/3* | 0/3* | 1/3* | 0/5* | - | Large |
| T282 (Std) MOX2B | 5/5 | 7/10 | 3/9,0/1* | 0/2,0/1* | - | - | - | - | Small |
| T282 (MOX2B/2 grains Zr)** | 4/4* | 2/5* | 2/6* | - | - | - | - | - | Small |
| T282 (MOX2B, Zr, w/o topoff)** | - | - | 2/2* | - | - | - | 3/3* | 1/3* | Large |
| T282-S.I.D. (Lead Shot plus Zr)** | - | - | - | - | 1/1* | - | 1/1* | 3/3* | Large |

* = Most Recent Firings

** = "Denver Incendiary Mix."



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FIGURE 3

FIRE FREQUENCY: 20MM HEI PROJECTILE VS MISS-DISTANCE TARGET

| PROJ. TYPE & FILLER | LATERAL DISTANCE FROM CELL ( INCHES ) | | | | | | LEAKAGE *** |
|---|---|---|---|---|---|---|---|
| | 6 | 9 | 12 | 15 | 18 | 27 | |
| M97 0% IM 142/ 100% Tetryl | - | - | 2/3* | - | 0/5* | - | M to L at 12" Small at 18" |
| M97 (Std) 30/70 | 2/2 | 2/5 | 2/3 | 2/3 | 0/3 | - | - - |
| M97 70/30 | 1/1 | 0/1,2/3* | | 0/3* | 0/2* | - | Large at 9" Small at 18" |
| M97 90/10 | 0/3 | - | - | - | - | - | - - |
| T282E1 (High Cap.) 0% IM/100% Tetryl | - | 1/3* | - | - | 1/3* | - | Med. at 9" Sm. at 18" |
| T282E1 30% IM/70% Tet. | - | 0/3* | 1/3* | - | 0/3* | - | M & S at 9" S at 18" |
| T282E1 70% IM/30% Tet. | - | 1/3* | - | 0/3* | - | - | S at 15" |
| T282E1 90% IM/10% Tet. | - | - | - | - | - | - | - |
| BRF 521 | 1/1* | 0/3* | - | - | - | - | S at 9" L at 6" |
| T216E1 (MOX / Zr.**) | - | 3/3 | - | - | 0/3 | 0/3 | - |
| T216E1 w/Heavy Base and MOX2B | - | - | - | - | 1/3* | 0/3* | Small |
| T282 (Std) MOX | - | 3/3 | - | - | 1/3 | 0/3 | - |
| T282 (MOX / Zr.**) | - | 3/3 | - | - | 0/3 | 0/3 | - |
| T282 (MOX / Zr.) w/o Topoff | - | 0/2* | - | - | - | - | None |
| T282E1 (S.I.D.) (Lead Shot / Zr.) | - | 0/3* | - | - | - | - | None |

* - More recent firings ('55 - '56)

** - "Denver Incendiary Mix".

*** - S - small, M - medium, L - large

C. OBSERVATIONS

1. An explosive type reaction accompanied the functioning of the BRF round. This reaction is attributed to the violent combination of the bromine pentafluoride filler with the hydrocarbon fuel. Target fuel cells were lifted and ruptured more violently by this than by the other rounds fired under the same test conditions. Consistent fires were not produced by this round, although those produced were characteristically violent.

2. The increased leakage and apparent damage potential of the T216E1, modified at this station by inserting a 135-grain, .526-inch diameter steel slug in the bottom of the shell cavity, is worthy of further investigation.

## IV. CONCLUSIONS

A. The general expectations for the two types of targets used are substantiated in that:

1. When the trajectory of the projectile is perpendicular to the fuel cell wall (B-2 mockup target), higher percentages of incendiary mix generally increase the incendiary effectiveness of 20mm rounds.

2. When the trajectory is parallel to the fuel cell wall (Miss-Distance target), higher percentages of incendiary mix decrease the maximum distance at which fuel fires can be caused.

B. The addition of two grams of ~~zirconium~~ of 20 - 60 mesh, Tyler screen, in the base of the T282E1 projectile did not enhance the incendiary performance of this round.

C. The modification of the T216E1 utilizing a steel slug in the shell cavity has promise for increased ammunition effectiveness.

## V. RECOMMENDATIONS

A. Consideration should be given to varying the weight and granulation of the zirconium mix in order to improve its incendiary effectiveness.

B. The use of an inner projectile slug, and of a slug integral with the shell base, for follow-through incendiary effectiveness should be further investigated.

C. The same kinds of tests should be conducted for projectiles of 30mm and larger caliber to determine the optimum compromise for incendiary and structural damage.

D. Consideration should be given to development of a single, versatile target configuration for incendiary effectiveness evaluation.

SUBMITTED:

Arthur Pillersdorf

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REVIEWED:

Herbert L. Rosenberg

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Ray A. Pillivant

BENJAMIN S. GOODWIN
Assistant Director for Engineering Testing
Development and Proof Services

## REFERENCES

1. Memorandum from Director, BRL to Director, D&PS, 20 December 1954.

2. Teletype 31707 from Office, Chief of Ordnance - ORDTS to Aberdeen Proving Ground, November 1954.

3. APG Firing Records Nos. P55880 and P55926.

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APPENDICES

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APPENDIX A

Mr.RGBernier/amp/27215
20 December 1954

Director, Development & Proof Services
Attn: Mr. H. L. Rosenberg

Director, Ballistic Research Laboratories

Firings to Investigate the Effect of HEI Fillers

1. General. It is desired to obtain more data on the effect of HEI filler on the maximum distance from a fuel cell wall at which ignition can be obtained. Against tank walls perpendicular to the trajectory (B(2) mock-up) the incendiary mix seems to have the most value but against tank walls parallel to the trajectory (miss distance mock-up) the HE seems to have the most value. A considerable amount of data already has been collected on this subject (APG Firing Records P-55880 and P-55926 and others), but more is needed to complete the evaluation.

2. Firings. The following specially filled 20mm shell will be needed, and it is believed that the filling can be accomplished at the APG HE plant. All the projectiles should be assembled with M505 sensitive fuzes and cases convenient for firing at approximately 2900 fps. The suggested firing conditions are also listed.

| Min* Quantity Needed | Shell Body (20mm) | % Incendiary (IM 142 or IM 11) | % HE Tetryl | Firings Needed B(2) M.U. | Miss Dist M. U. |
|---|---|---|---|---|---|
| | | | | Distance (in.) | |
| 6 | M97 | 0 | 100 | 36 | 12 |
| 3 | " | Standard | Standard | 45 | None |
| 6 | " | 70 | 30 | 45 | 9 |
| 3 | " | 90 | 10 | 45 | None |
| 6 | T216 or T282 | 0 | 100 | 18 | 18 |
| 6 | " | 30 | 70 | 27 | 12 |
| 6 | " | 70 | 30 | 45 | 9 |
| 3 | " | 90 | 10 | 45 | None |

*Additional samples of three rounds should be fired at a slightly greater distance if fires occur.

Firings should be conducted against B-50 tanks filled with aviation gasoline. Dural approx. .051" thick may be used for function plate on miss distance firings. For the B(2) mock-up firings approx. .040" is adequate for the function plate and .125" for the second plate, but the backing board and second plate should cover the entire impact face of the tank. Shell filler weights should be recorded. For the previous firings the IM 142 was pressed at 40,000 psi and the tetryl topping off at 20,000 psi. The fuze cavity was drilled .385" ∕ .010".

3. Firings are chargeable to Project TB3-0238A. Results should be classified "Confidential". Work order 962-010-01.

G. E. PARSONS, Jr.
Lt Colonel, Ord. Corps
Assistant to Director
Ballistic Research Laboratories

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FOR TERMINAL BALLISTICS OF A/C AMM BR CMM D AND PS FROM ORDTS KLINE TT ORD 31707 RE FONECON KLINE-ROSENBERG 10 NOV 54 CMM APPROXIMATELY 250 EACH T282E1 AND T216E1 20MM HEI PROJECTILES HAVE BEEN FORWARDED YOUR STATION FROM DENVER RESEARCH INSTITUTE PD THESE PROJECTILES CONTAIN 2 GRAINS DENVER INCENDIARY MIX AS BASE CHARGE WITH BALANCE CONVENTIONAL MOX CAPPING PD REQUEST YOUR STATION CONDUCT SUCH TESTS AS NECESSARY TO DETERMINE COMPARATIVE BLAST AND INCENDIARY PERFORMANCE OF THESE PROJECTILES AND CONVENTIONAL LOADED ONES UNDER SEA LEVEL AND ATMOSPHERIC CONDITIONS PD CHARGE COSTS TO PROJECT T31-47

CFN 31707 10 54 250 T282E1 T216E1 20MM 2 T31-47

15/1539Z

APPENDIX B

TABLE 3 - ROUND-BY-ROUND DATA

Projectile: M-97 0% IM 100% Tetryl

| TEST ROUND NO. | TARGET | DISTANCE | FIRE YES | FIRE NO | LEAK IN CELL |
|---|---|---|---|---|---|
| 158 | B-2 | 36 | | X | |
| 159 | B-2 | 36 | X | | |
| 160 | B-2 | 36 | X | | |
| 161 | B-2 | 45 | | X | |
| 162 | B-2 | 45 | X | | |
| 163 | B-2 | 45 | | X | |
| 169 | B-2 | 54 | | X | |
| 170 | B-2 | 54 | X | | |
| 171 | B-2 | 63 | Disregard | | |
| 172 | B-2 | 63 | X | | |
| 179 | MD | 12 | Disregard | | |
| 180 | MD | 12 | Disregard | | |
| 181 | MD | 12 | | X | Large |
| 182 | MD | 12 | X | | Medium |
| 183 | MD | 12 | X | | Large |
| 191 | MD | 18 | | X | Small |
| 192 | MD | 18 | | X | Small |
| 193 | MD | 18 | Disregard | | |
| 194 | MD | 18 | Disregard | | |
| 195 | MD | 18 | | X | Medium |
| 286 | MD | 18 | | X | Small |
| 287 | B-2 | 72 | | X | Small |
| 288 | B-2 | 72 | Disregard | | |
| 289 | B-2 | 72 | | X | Small |
| 290 | B-2 | 72 | | X | Small |
| 293 | MD | 18 | | X | Small |
| 298 | B-2 | 54 | | X | Small |
| 299 | B-2 | 54 | | X | Small |
| 300 | B-2 | 54 | | X | Small |
| 301 | B-2 | 36 | | X | Small |
| 302 | B-2 | 36 | | X | Small |
| 303 | B-2 | 18 | | X | Small |

Projectile: M-97 (Std) 30% IM 70% Tetryl

| TEST ROUND NO. | TARGET | DISTANCE | FIRE YES | FIRE NO | LEAK IN CELL |
|---|---|---|---|---|---|
| 1 | B-2 | 45 | | X | |
| 2 | B-2 | 22 | | X | |
| 3 | B-2 | 12 | Disregard | | |
| 4 | B-2 | 18 | X | | |
| 5 | B-2 | 45 | | X | |
| 6 | B-2 | 45 | | X | |
| 7 | B-2 | 27 | X | | |
| 8 | B-2 | 27 | | X | |
| 295 | B-2 | 54 | | X | Small |
| 296 | B-2 | 54 | | X | Small |
| 297 | B-2 | 54 | | X | Small |
| 304 | B-2 | 27 | X | | Medium |

Projectile: M-97 70% IM 30% Tetryl

| TEST ROUND NO. | TARGET | DISTANCE | FIRE YES | FIRE NO | LEAK IN CELL |
|---|---|---|---|---|---|
| 152 | B-2 | 45 | X | | |
| 153 | B-2 | 45 | | X | |
| 154 | B-2 | 45 | X | | |
| 173 | B-2 | 54 | X | | |
| 174 | B-2 | 63 | X | | |
| 175 | B-2 | 72 | | X | |
| 176 | B-2 | 72 | | X | |
| 177 | B-2 | 72 | X | | |
| 184 | MD | 9 | X | | Large |
| 185 | MD | 9 | | X | Small |
| 186 | MD | 9 | X | | Large |
| 187 | MD | 18 | Disregard | | |
| 188 | MD | 18 | | X | Small |
| 189 | MD | 18 | Disregard | | |
| 190 | MD | 18 | | X | Small |
| 210 | B-2 | 96 | | X | Medium |
| 211 | B-2 | 96 | | X | Medium |
| 283 | MD | 15 | | X | Medium |
| 284 | MD | 15 | | X | Small |
| 285 | MD | 15 | | X | Small |
| 294 | B-2 | 96 | | X | Medium |

Projectile: M-97 90% IM 10% Tetryl

| TEST ROUND NO. | TARGET | DISTANCE | FIRE YES | FIRE NO | LEAK IN CELL |
|---|---|---|---|---|---|
| 155 | B-2 | 45 | X | | |
| 156 | B-2 | 45 | X | | |
| 157 | B-2 | 45 | X | | |
| 164 | B-2 | 45 | X | | |
| 165 | B-2 | 54 | X | | |
| 166 | B-2 | 63 | | X | |
| 167 | B-2 | 63 | | X | |
| 168 | B-2 | 63 | X | | |
| 178 | B-2 | 72 | | X | |
| 196 | MD | 9 | Disregard | | |
| 197 | MD | 9 | Disregard | | |
| 198 | MD | 9 | Disregard | | |
| 199 | MD | 9 | Disregard | | |
| 203 | B-2 | 72 | X | | Large |
| 204 | B-2 | 72 | Disregard | | |
| 205 | B-2 | 96 | Disregard | | |
| 206 | B-2 | 72 | Disregard | | |
| 207 | B-2 | 96 | | X | Large |
| 208 | B-2 | 96 | Disregard | | |
| 209 | B-2 | 96 | | X | Large |
| 291 | B-2 | 72 | | X | Large |
| 292 | B-2 | 96 | X | | Large |

Projectile: T282 0% IM 100% Tetryl

| TEST ROUND NO. | TARGET | DISTANCE | FIRE YES | FIRE NO | LEAK IN CELL |
|---|---|---|---|---|---|
| 95 | B-2 | 18 | Disregard | | |
| 96 | B-2 | 18 | | X | |
| 97 | B-2 | 18 | | X | |
| 98 | B-2 | 18 | | X | |
| 110 | B-2 | 45 | | X | |
| 116 | MD | 18 | | X | |
| 117 | MD | 18 | | X | |
| 118 | MD | 18 | Disregard | | |
| 119 | MD | 18 | X | | |
| 202 | MD | 9 | | X | Medium |
| 328 | MD | 9 | | X | Medium |
| 331 | MD | 9 | X | | Medium |

Projectile: T282 30% IM 70% Tetryl

| TEST ROUND NO. | TARGET | DISTANCE | FIRE YES | FIRE NO | LEAK IN CELL |
|---|---|---|---|---|---|
| 99 | B-2 | 27 | | X | |
| 100 | B-2 | 27 | Disregard | | |
| 101 | B-2 | 27 | Disregard | | |
| 102 | B-2 | 27 | | X | |
| 103 | B-2 | 27 | X | | |
| 120 | MD | 12 | | X | |
| 121 | MD | 12 | X | | |
| 122 | MD | 12 | | X | |
| 200 | MD | 18 | | X | Small |
| 201 | MD | 18 | | X | Small |
| 311 | B-2 | 36 | Disregard | | |
| 312 | B-2 | 36 | | X | Small |
| 313 | B-2 | 36 | | X | Small |
| 314 | B-2 | 36 | | X | Small |
| 323 | MD | 18 | | X | Small |
| 324 | MD | 9 | | X | Medium |
| 329 | MD | 9 | | X | Small |
| 330 | MD | 9 | | X | Small |

Projectile: T282 70% IM 30% Tetryl

| TEST ROUND NO. | TARGET | DISTANCE | FIRE YES | FIRE NO | LEAK IN CELL |
|---|---|---|---|---|---|
| 104 | B-2 | 45 | X | | |
| 105 | B-2 | 45 | X | | |
| 106 | B-2 | 45 | X | | |
| 111 | MD | 9 | | X | |
| 112 | MD | 9 | Disregard | | |
| 113 | MD | 9 | Disregard | | |
| 114 | MD | 9 | | X | |
| 115 | MD | 9 | X | | |
| 315 | B-2 | 54 | X | | Large |
| 316 | B-2 | 63 | | X | Medium |
| 317 | B-2 | 54 | | X | Medium |
| 318 | B-2 | 54 | X | | Large |
| 319 | B-2 | 63 | | X | Medium |
| 320 | B-2 | 63 | | X | Medium |
| 325 | MD | 15 | | X | Small |
| 326 | MD | 15 | | X | Small |
| 327 | MD | 15 | | X | Small |

Projectile: T282 90% IM 10% Tetryl

| TEST ROUND NO. | TARGET | DISTANCE | FIRE YES | FIRE NO | LEAK IN CELL |
|---|---|---|---|---|---|
| 107 | B-2 | 45 | X | | |
| 108 | B-2 | 45 | X | | |
| 109 | B-2 | 45 | X | | |
| 212 | B-2 | 72 | X | | Large |
| 213 | B-2 | 96 | | X | Large |
| 214 | B-2 | 96 | X | | Large |
| 215 | B-2 | 96 | | X | Large |
| 321 | B-2 | 72 | X | | Large |
| 322 | B-2 | 72 | X | | Large |

Projectile: T282 Standard

| TEST ROUND NO. | TARGET | DISTANCE | FIRE YES | FIRE NO | LEAK IN CELL |
|---|---|---|---|---|---|
| 9 | B-2 | 10 | X | | |
| 10 | B-2 | 18 | X | | |
| 11 | B-2 | 27 | X | | |
| 12 | B-2 | 18 | X | | |
| 13 | B-2 | 18 | X | | |
| 14 | B-2 | 27 | | X | |
| 15 | B-2 | 27 | | X | |
| 16 | B-2 | 36 | X | | |
| 17 | B-2 | 36 | Disregard | | |
| 18 | B-2 | 36 | Disregard | | |
| 19 | B-2 | 45 | | X | |
| 20 | B-2 | 18 | X | | |
| 21 | MD | 9 | Disregard | | |
| 22 | MD | 9 | X | | |
| 23 | B-2 | 45 | | X | |
| 24 | MD | 9 | X | | |
| 73 | MD | 9 | X | | |
| 74 | MD | 18 | | X | |
| 75 | MD | 18 | | X | |
| 76 | MD | 18 | X | | |
| 84 | MD | 27 | | X | |
| 85 | MD | 27 | | X | |
| 86 | MD | 27 | | X | |
| 92 | B-2 | 36 | | X | |
| 93 | B-2 | 36 | | X | |
| 94 | B-2 | 36 | | X | |
| 222 | B-2 | 45 | | X | Small |
| 223 | B-2 | 36 | | X | Small |

Projectile: T282 MOX2B / Zr

| TEST ROUND NO. | TARGET | DISTANCE | FIRE YES | FIRE NO | LEAK IN CELL |
|---|---|---|---|---|---|
| 40 | B-2 | 18 | X | | |
| 41 | B-2 | 18 | X | | |
| 42 | B-2 | 18 | X | | |
| 43 | B-2 | 27 | | X | |
| 44 | B-2 | 27 | | X | |
| 45 | B-2 | 27 | X | | |
| 46 | B-2 | 12 | Disregard | | |
| 47 | B-2 | 36 | | X | |
| 48 | B-2 | 36 | | X | |
| 49 | B-2 | 36 | | X | |
| 50 | B-2 | 18 | X | | |
| 56 | MD | 9 | X | | |
| 57 | MD | 9 | X | | |
| 58 | MD | 9 | Disregard | | |
| 59 | MD | 9 | X | | |
| 60 | MD | 18 | | X | |
| 61 | MD | 18 | | X | |
| 62 | MD | 18 | Disregard | | |
| 63 | MD | 18 | Disregard | | |
| 64 | MD | 18 | | X | |
| 65 | MD | 27 | | X | |
| 66 | MD | 27 | | X | |
| 67 | MD | 27 | | X | |
| 230 | B-2 | 36 | | X | Small |
| 231 | B-2 | 27 | X | | Small |
| 232 | B-2 | 27 | | X | Small |
| 233 | B-2 | 36 | X | | Small |
| 234 | B-2 | 36 | X | | Small |

Projectile: T216E1 MOX / Zr

| TEST ROUND NO. | TARGET | DISTANCE | FIRE YES | FIRE NO | LEAK IN CELL |
|---|---|---|---|---|---|
| 25 | B-2 | 36 | Disregard | | |
| 26 | B-2 | 45 | | X | |
| 27 | B-2 | 45 | | X | |
| 28 | B-2 | 45 | | X | |
| 29 | B-2 | 18 | X | | |
| 30 | B-2 | 18 | Disregard | | |
| 31 | B-2 | 18 | | X | |
| 32 | B-2 | 18 | Disregard | | |
| 33 | B-2 | 18 | X | | |
| 34 | B-2 | 27 | X | | |
| 35 | B-2 | 27 | X | | |
| 36 | B-2 | 27 | Disregard | | |
| 37 | B-2 | 27 | X | | |
| 38 | B-2 | 36 | | X | |
| 39 | B-2 | 36 | | X | |
| 51 | MD | 9 | Disregard | | |
| 52 | MD | 9 | Disregard | | |
| 53 | MD | 9 | Disregard | | |
| 54 | MD | 9 | Disregard | | |
| 55 | MD | 9 | Disregard | | |
| 68 | MD | 9 | X | | |
| 69 | MD | 9 | Disregard | | |
| 70 | MD | 9 | Disregard | | |
| 71 | MD | 9 | X | | |
| 72 | MD | 9 | X | | |
| 77 | MD | 18 | | X | |
| 78 | MD | 18 | Disregard | | |
| 79 | MD | 18 | | X | |
| 80 | MD | 18 | | X | |
| 81 | MD | 27 | | X | |
| 82 | MD | 27 | | X | |
| 83 | MD | 27 | | X | |
| 87 | B-2 | 36 | Disregard | | |
| 88 | B-2 | 36 | | X | |
| 89 | B-2 | 9 | X | | |
| 90 | B-2 | 9 | X | | |
| 91 | B-2 | 9 | X | | |
| 229 | B-2 | 36 | | X | Small |
| 225 | B-2 | 36 | X | | Small |
| 226 | B-2 | 36 | | X | Small |
| 227 | B-2 | 27 | | X | Small |
| 229 | B-2 | 36 | | X | Small |

Projectile: T282 MOX2B / Zr (Without Topoff)

| TEST ROUND NO. | TARGET | DISTANCE | FIRE YES | FIRE NO | LEAK IN CELL |
|---|---|---|---|---|---|
| 235 | B-2 | 36 | X | | Large |
| 236 | B-2 | 36 | X | | Large |
| 237 | B-2 | 72 | X | | Large |
| 238 | B-2 | 72 | X | | Large |
| 253 | B-2 | 96 | | X | Large |
| 254 | B-2 | 96 | | X | Large |
| 255 | B-2 | 96 | X | | Large |
| 256 | B-2 | 72 | X | | Large |
| 267 | MD | 9 | | X | None |
| 268 | MD | 9 | | X | None |

Projectile: T282 SID (Lead Shot / Zr)

| TEST ROUND NO. | TARGET | DISTANCE | FIRE YES | FIRE NO | LEAK IN CELL |
|---|---|---|---|---|---|
| 274 | B-2 | 54" | X | | Large |
| 275 | B-2 | 72" | X | | Large |
| 276 | B-2 | 96" | Disregard | | |
| 277 | B-2 | 96" | X | | Large |
| 278 | B-2 | 96" | X | | Large |
| 279 | B-2 | 96" | X | | Large |
| 280 | MD | 9 | | X | None |
| 281 | MD | 9 | | X | None |
| 282 | MD | 9 | | X | None |

Projectile: T216E1 (MOX2B) (Heavy Base - Slug added in the bottom of the projectile - Slug Dimensions - Height .314, Diameter .526, Weight 135 grain)

| TEST ROUND NO. | TARGET | DISTANCE | FIRE YES | FIRE NO | LEAK IN CELL |
|---|---|---|---|---|---|
| 216 | B-2 | 72 | | X | Medium |
| 217 | B-2 | 63 | X | | Medium |
| 218 | B-2 | 72 | | X | Medium |
| 219 | B-2 | 72 | Disregard | | |
| 220 | B-2 | 72 | | X | Medium |
| 221 | B-2 | 63 | Disregard | | |
| 228 | B-2 | 63 | | X | Medium |
| 257 | B-2 | 72 | | X | Medium |
| 258 | B-2 | 72 | | X | Medium |
| 259 | B-2 | 63 | | X | Medium |
| 261 | MD | 18 | | X | Small |
| 262 | MD | 18 | | X | Small |
| 263 | MD | 18 | X | | Small |
| 264 | MD | 27 | | X | Small |
| 265 | MD | 27 | | X | Small |
| 266 | MD | 27 | | X | Small |
| 269 | MD | 9 | Disregard | | |
| 305 | B-2 | 54 | | X | Large |
| 306 | B-2 | 45 | | X | Large |
| 307 | B-2 | 45 | | X | Large |
| 308 | B-2 | 45 | X | | Large |
| 309 | B-2 | 54 | | X | Large |
| 310 | B-2 | 54 | | X | Large |

Projectile: BRF-521

| TEST ROUND NO. | TARGET | DISTANCE | FIRE YES | FIRE NO | LEAK IN CELL |
|---|---|---|---|---|---|
| 239 | B-2 | 54 | | X | Large |
| 240 | B-2 | 54 | X | | Large |
| 241 | B-2 | 96 | Disregard | | |
| 242 | B-2 | 96 | | X | Large |
| 243 | B-2 | 63 | | X | Large |
| 244 | B-2 | 63 | X | | Large |
| 245 | B-2 | 63 | | X | Large |
| 246 | B-2 | 54 | X | | Large |
| 247 | B-2 | 72 | | X | Large |
| 248 | B-2 | 72 | X | | Large |
| 249 | B-2 | 72 | Disregard | | |
| 250 | B-2 | 72 | X | | Large |
| 251 | B-2 | 96 | | X | Large |
| 252 | B-2 | 96 | Disregard | | |
| 260 | B-2 | 96 | X | | Large |
| 270 | MD | 9 | | X | Small |
| 271 | MD | 6 | X | | Large |
| 272 | MD | 9 | | X | Small |
| 273 | MD | 9 | | X | Small |